Integrating deep learning into CAD/CAE system: generative design and evaluation of 3D conceptual wheel

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Abstract

Engineering design research integrating artificial intelligence (AI) into computer-aided design (CAD) and computer-aided engineering (CAE) is actively being conducted. This study proposes a deep learning-based CAD/CAE framework in the conceptual design phase that automatically generates 3D CAD designs and evaluates their engineering performance. The proposed framework comprises seven stages: (1) 2D generative design, (2) dimensionality reduction, (3) design of experiment in latent space, (4) CAD automation, (5) CAE automation, (6) transfer learning, and (7) visualization and analysis. The proposed framework is demonstrated through a road wheel design case study and indicates that AI can be practically incorporated into an end-use product design project. Engineers and industrial designers can jointly review a large number of generated 3D CAD models by using this framework along with the engineering performance results estimated by AI and find conceptual design candidates for the subsequent detailed design stage.